

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
11 October 2001 (11.10.2001)

PCT

(10) International Publication Number  
**WO 01/75551 A2**

- (51) International Patent Classification<sup>7</sup>: **G06F**
- (21) International Application Number: PCT/US01/10575
- (22) International Filing Date: 30 March 2001 (30.03.2001)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
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- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:**  
— *without international search report and to be republished upon receipt of that report*
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*



WO 01/75551 A2

(54) Title: ADDRESS PRESENTATION SYSTEM

(57) **Abstract:** An approach for providing retrieval of information via a geographic information system that uses a robust, standardized architecture. A user utilizing a client station is able to obtain, for example, telecommunication information by supplying input address information and optionally, user supplied selection criteria. An application server receives the input address information. A database server communicates with the application server; the database server is configured to validate and geocode the input address information. The database server outputs validated address information and positional information to the application server. The database server is coupled to numerous data sources. The database server retrieves the telecommunication information based upon the selection criteria and transmits the telecommunication information to the application server, which can generate a map graphic based upon the validated address and the positional information from the database server. The application server permits overlay of the telecommunication information onto the map graphic.

## ADDRESS PRESENTATION SYSTEM

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BACKGROUND OF THE INVENTIONField of the Invention:

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The present invention relates to an information processing system, and is more particularly related to a geographic information system supporting location of potential customers and/or facilities relative to existing facilities and/or infrastructure for retail, wholesale, commercial, utilities, or other purposes.

### Discussion of the Background

Companies seeking to deliver products and/or services to existing or potential customers face a number of challenges relating to decisions as to how best serve customers in a particular geographic region. For example, all types of companies face decisions dealing with provisioning products or services within a particular geographic region by relating address information to existing or potential delivery capabilities. These decisions pose a number of information management challenges with respect to providing products or services to a customer which directly impacts the ability to be competitive and responsive to customers.

For example, telecommunication service providers, which include exchange carriers, access providers, and content providers and the like, face information management challenges with respect to their networks, spanning engineering and marketing organizations. Because telecommunication services are regional in nature, geographic considerations arise throughout the process of providing telecommunications services to a customer. These considerations directly impact the ability to be competitive and responsive to customers.

However, the ability to be competitive and responsive to customers is certainly not unique to telecommunications companies. In fact, these challenges are faced with respect to all entities delivering products and/or services based on: location of customers; location and availability of resources; or any other business-related data or selection criteria related to geographic, such as input address information, or non-geographic information.

Examples of industries facing such challenges include, but are by no means limited to agriculture, forestry, fishing, mining, construction, manufacturing, transportation,

communications, electric, gas, sanitary services, wholesale trade, retail trade, finance, insurance, real estate, provision of any services in general, public administration, and nonclassifiable establishments. Additional examples include railroad transportation, local and interurban passenger transit, trucking and warehousing, postal service, water transportation, transportation  
5 by air, pipelines, transportation services, and sanitary services, electric utilities, cable television providers, internet service providers. Still further examples include owners of and suppliers of/to: building materials and garden supplies, general merchandise stores, food stores, automotive dealers and service stations, apparel and accessory stores, furniture and home-furnishings stores, eating and drinking places, and miscellaneous retail. The list of product  
10 and/or service providers is literally endless.

Yet, what all these providers have in common is the need to better service their existing or potential customers/resources in a particular geographic locale. Traditionally, when companies perform prospecting, market analysis, and network planning the focus has been on using demographic data alone, without factoring in customer location information. As markets for any  
15 product or service continue to open up, competition necessarily steers attention to better serving the needs of the customers. All companies in all types of industries seek to delivery products and/or services better, faster, and more efficiently. This enables the company to better ensure their survival as compared to the way their competitors do business in the particular geographic region of interest.

20 Taking the telecommunications market purely as an example, the needs discussed herein require the telecommunication service providers to target customers with greater precision. Misdirected marketing results in waste of valuable resources. Information regarding service

availability and rates within a target area are useful in supporting customers' service requirements. Additionally, knowledge of the locations of the facilities that best serve the target market promotes network efficiency. For instance, in targeting potential customers, product and/or service providers need to know where the best prospects are located. The selection of collocation sites, mapping of service areas, and determination of a prospect's proximity to the local city network are difficult, if not impractical, tasks to perform. Geographic information, thus, plays an ever-increasing role in servicing customers. The conventional approach to processing geographic information employs numerous disparate, non-integrated legacy systems to consolidate information on location of facilities, extent of network service coverage, and so on. These legacy systems, from which information are gathered and processed, do not share a standardized interface, and thus, require costly customized development to interact with external systems.

The traditional Bellcore solution to the problem of maintaining spatial (i.e., geographical) information is a combination of vertical and horizontal coordinates and the SAG (Street Address Guide). For example, buildings are located using Bellcore Vertical and Horizontal (V&H) coordinates. In the case of access services, vertical and horizontal coordinates lack granularity because it is a "large area" geographical solution with resolution of one mile. This solution has been adequate for large customers with large orders; however, as telecommunication service providers penetrate smaller markets, geographic inaccuracies will result in increased costs. A number of other industry changes in the local telecommunications service arena, including local number portability, rate center consolidation, and number pooling require a solution that overcomes the deficiencies of a large area geographical system.

For example, placement of long distance facilities have been dictated by the ILEC (Incumbent Local Exchange Carrier) wire center and LATA (Local Access and Transport Area). By and large, the ILEC has been responsible for providing access to the customer location. With the advent of new technologies, such as digital subscriber line (DSL), the emergence of CLECs (Competitive Local Exchange Carriers) has been steady. It is evident that reliance on the ILEC as the source of geographical information is no longer a viable solution as ILECs would inherently be reluctant to assist their competition.

Because of the increased competition, for example, in the local exchange market, the customers are afforded the choice of selecting among a number of telecommunication service providers. However, the customers demand that they be able to maintain their local telephone numbers. Undoubtedly, local number portability presents a key issue to these telecommunication service providers; namely, the new telecommunication service provider has only the phone numbers associated with the incumbent telecommunication service provider for locating appropriate facilities to serve new customers.

The traditional approach has been to obtain the incumbent provider's facilities information using the customers' phone numbers, and subsequently mapping such information to the facilities of the new telecommunication service provider. In other words, CLECs have relied on a customer's existing and/or nearby telephone number for switch homing, wire center determination, rate center determination, and the customer's PSAP (Public Safety Answering Point) area; however, the relationship between the customer's NPA/NXX (Numbering Plan Area/3-digit telco central office number) and address continually changes. Consequently,

relying on a customer's NPA/NXX to determine a switch service area is not practical in the long-term. It is clear that phone numbers provide an inefficient way to capture spatial information.

Based on the foregoing, there is a clear need in all industries for improved approaches for maintaining geographic information relating to all types of products and service availability, as well as customer availability and location. As stated above, this information is useful in many arenas, and is not limited to use in providing telecommunication services.

There is also a need to provide an integrated system for the retrieval and maintenance of spatial information related to a region of business interest.

There is also a need to minimize development cost by utilizing standardized hardware and software platforms.

There is yet a further need to increase the accuracy and to streamline the processes of prospecting, marketing, and strategic planning of product/service/infrastructure provisioning. Based on the need of prospecting, marketing, and strategic planning of the delivery of products/services and infrastructure, an approach for implementing a geographically enabled information system is highly desirable.

There is also a need for a map-graphic based icon distance calculator that allows for easy distance calculations to transpire, either alone or in conjunction with other aspects of the invention based on relevant geographic or non-geographic information, based upon input address information and specific desired criteria.

There is still further need for a movable map legend associated with a map-graphic to allow for easy positioning of the legend so as not to interfere with viewing presented information. This need extends for use either alone or in conjunction with other aspects of the

invention based on relevant geographic or non-geographic information, based upon input address information and specific desired criteria.

There is yet a still further need for a continuous zoom bar associated with a map-graphic to allow for quick and precise zooming of the map-graphic. This need extends for use either alone or in conjunction with other aspects of the invention based on relevant geographic or non-geographic information, based upon input address information and specific desired criteria.

### SUMMARY OF THE INVENTION

The invention, and exemplary embodiments described within, could have application, in whole or in part, in many different utilities and other non-utilities industries, as well as in commercial ventures in general. The examples of uses of the inventions described herein, either as a group or individually, include the telecommunications industry and other utilities to track network or other assets and facilities, to determine placement of new facilities, to determine relevant facilities for a new customer, or to track facilities used by customers. Non-utility industries and other commercial ventures could use individual tools associated with this invention described herein. For example, any industry could benefit from using a push-pin distance calculator for calculating distances between relevant facilities, in single steps ('straight-line') or multiple steps (e.g. street distance); or to present information to customers or potential customers, or to visualize geographic information to display for use in sales, marketing, ordering, or delivery, and so on.

Of course, any other aspects of the present invention may also be used in combination with other industry-specific applications or alone. For example, this invention, with



modifications which are clearly understood by those within ordinary skill in the art, would be able to serve non-telecommunications industry areas in addition to the telecommunications industry examples disclosed. Exemplary changes to the telecommunications examples mentioned herein include the trucking and warehousing industry, or the food stores and grocery delivery industry, or even the real estate industry.

In the case of trucking and warehousing, a warehousing company might have specific warehouse facilities locations which store inventory for a given geographic region corresponding in much the same way as the wire center in the exemplary telecommunications embodiments described herein. The invention could be used to determine, based on the input address of the client, which of the warehouses should be used to store the inventory for that client, and therefore which truck dispatch should occur. The invention can be used to plan routes using a push-pin distance calculator based on selected criteria based on geographic and non-geographic data.

In the case of food stores, a food store might have specific locations which supply retail food to a given geographic area, corresponding in much the same way as the wire center in the exemplary telecommunications embodiments described herein. The invention could be used to determine, based on the customer's address, which food store that customer should visit for their provisions, or which food store should fill the customer's order if it is remotely requested by that customer.

In the case of real estate, a real estate company could designate specific regions, zones, or territories for their real estate agents to work within, corresponding in much the same way as the wire center in the exemplary telecommunications embodiments described herein. Additionally, they could establish certain regions or zones for specific real estate features (e.g., school districts)

corresponding to rate centers. The inventions could be used to identify agents with territories in certain school districts; or addresses (listings) in an agent's territory, and so on.

For the specific capabilities, like the push pin tool: the distance calculation capability described herein could be used in industries such as construction. In an industry like construction, the push pin distance calculation tool could be used to measure the street distance along truck routes from interstate exits to job sites in order to ensure trucks are taking the shortest, and likely fastest, path to the designated site. The invention can be used to plan routes using the push-pin distance calculator based on selected criteria based on geographic and non-geographic data. This allows criteria to be considered in route planning, such as whether construction trucks are allowed on certain streets or highways. The push-pin distance calculator can be used either alone or in conjunction with other aspects of the invention relating to the planning of routes based on relevant geographic or non-geographic information, based upon input address information and specific desired criteria.

Another exemplary use of the push-pin distance calculator is for determining distances of marathons, races, an even for tax purposes related to mileage, either alone or in conjunction with other aspects of the invention relating to the planning of routes based on relevant geographic or non-geographic information, based upon input address information and specific desired criteria.

Another specific capability includes a movable map legend that can be used, either alone or in conjunction with other aspects of the invention relating to the planning of routes based on relevant geographic or non-geographic information, based upon input address information and specific desired criteria. The movable map legend allows a user to move a map legend within a

user interface, and have the legend return to the position the legend was placed last by the particular user.

Yet another specific capability includes a continuous zoom bar that can be used in conjunction with or separate from a system that provides the industry-specific information relative to a geographic region. The continuous zoom bar allows a user to position an input device such as a cursor over a zoom bar which has a level of zoom associated with the position within the zoom bar. This feature allows users to easily specify the level of zoom.

According to one aspect of the invention, a method is provided of utilizing a geographical information system, the method comprising receiving input address information; geocoding the input address information; and outputting positional information in response to the geocoding step. Under this approach, prospecting, marketing, and strategic planning of services are accomplished with increased accuracy and efficiency. This approach is particularly useful with respect to telecommunication services, but is not limited to this use.

According to another aspect of the invention, a geographic information system is provided, comprising: an application server configured to receive input address information, selection criteria corresponding to the requested information; a database server communicating with the application server, the database server configured to validate and geocode the input address information, the database server outputting validated address information and positional information to the application server; and a data source coupled to the database server, the database server retrieving the requested information based upon the selection criteria and transmitting the requested information to the application server, wherein the application server selectively generates a map graphic based upon the validated address and the positional

information from the database server. The above arrangement advantageously provides use of standardized hardware and software platforms, thereby minimizing development costs.

According to yet another aspect of the invention, a geographic information system is provided, comprising: an application server configured to receive requested information  
5 including input address information; a database server communicating with the application server, the database server configured to geocode the input address information; and a data source coupled to the database server, the database server retrieving the requested information based upon the geocoded input address. The above arrangement also advantageously provides use of standardized hardware and software platforms, thereby minimizing development costs.

10 In a still further aspect of the invention, a computer-readable medium carrying a sequences of instructions for utilizing a geographical information system is provided, the sequences of instructions including instructions which, when executed by a processor, cause the processor to perform the steps of: receiving input address information; geocoding the input address information to generate positional information; and retrieving requested information  
15 based upon the positional information.

In another aspect of the invention, a method is provided for determining service availability using a geographical information system, the method comprising: providing address information and a selection criterion; retrieving requested information based upon the address information and the selection criteria, the retrieving step comprising, geocoding the address  
20 information, and outputting positional information. Under this arrangement, users can provision products/services rapidly and efficiently.

In a still further aspect of the invention, a memory is provided for storing spatial data and requested information, comprising a data structure including: an address table for storing input address information, the input address information being geocoded to generate positional information, the address table comprising a positional information field for storing the generated positional information; and an information table for storing the requested information, the requested information being retrieved based upon the generated positional information. The memory is structured to enable access of relevant industry-specific information based on geographic and non-geographic data, based upon input address information and specific desired criteria.

These approaches advantageously enhance business processing of any type of product and/or service, whether it is related to utility services such as telecommunications, or the broad array of business applications discussed above. An example of the universal application of the inventive subject matter includes any type of product or service sales distribution resource. The map and requested information may relate to location of existing customers, potential customers, consumers of related or non-related products/service, location of product, location of sales personal, location of sales facilities, and so on. The possibilities are endless. Many of the examples described herein relate to utilizing address information converting the information to geospatial information, and relating the geospatial information to other information for comparison purposes. However, it is readily understood by one of ordinary skill in the art that this invention has applicability to any other industry and would be readily adaptable thereto without undue experimentation using the principles described herein.

### BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

5 Figure 1 is a block diagram of the hardware architecture of the address presentation system (APS), in accordance with an embodiment of the present invention;

Figure 2 is diagram of the software architecture of the system of Figure 1;

Figure 3 is a diagram illustrating the operation of the APS of Figure 1;

10 Figure 4 is a flow chart of the address validation and geocoding process, according to an embodiment of the present invention;

Figure 5 is an address entry screen of a graphical user interface (GUI) of the APS, according to an embodiment of the present invention;

15 Figures 6A and 6B are a map and information screen of a GUI, according to an embodiment of the present invention;

Figure 6C is a flow chart of the distance calculation operation supported by the GUI of Figure 6B;

Figure 7 is a diagram of a map legend in the GUI of Figure 6A;

20 Figure 8 is an address entry screen of a GUI, according to an embodiment of the present invention;

Figure 9 is a retrieved information screen of a GUI indicating unavailability of service, according to an embodiment of the present invention;

Figures 10A and 10B are a retrieved information screen of a GUI indicating availability of service, according to an embodiment of the present invention;

Figure 11 is a failed address validation screen of a GUI, according to an embodiment of the present invention;

5 Figure 12 is a diagram of the data structure used in the address presentation system of Figure 1; and

Figure 13 is a diagram of a computer system that can perform in accordance with an embodiment of the present invention.

#### 10 DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following description, for the purpose of explanation, specific details are set forth in order to provide a thorough understanding of the invention. However, it will be apparent that the invention may be practiced without these specific details. For instance, repeated use of telecommunications-related products/services are used to provide a consistent exemplary  
15 industry application, but are in no way intended to limit the scope of the invention to applicability to only this industry since universal application to any other product/service arena is intended. In some instances, well-known structures and devices are depicted in block diagram form in order to avoid unnecessarily obscuring the present invention. Although the present invention is discussed with respect to exemplary protocols, computer languages, and operating  
20 systems, the inventions can be implemented on any computer system regardless of protocols, languages, or operating system platform.

The present invention accomplishes effective retrieval of spatial information relating to, for example, telecommunication services and associated networks by utilizing a robust client/server architecture. Through a web client application, the user specifies various requested relevant geographic or non-geographic information regarding telecommunication facilities, services, and so on (collectively referred to as telecommunication information) and inputs address information into an address presentation system (APS). In turn, the APS sends a map, if requested, along with the requested telecommunication information to a client station, which displays the map and the requested information via a robust and intuitive graphical user interface (GUI). Among other functional capabilities, the GUI provides extensive zooming functionalities, distance calculation using "push-pin" icons, a user-customizable movable map legend, and map redraw capability within a single screen. The APS also supports desktop applications with targeted functionality, so that spatial information can be readily obtained through many types of client applications. The APS is based upon standards compliant client/server architecture, which includes an application server (e.g., web server) and a database server. Additionally, the APS utilizes a Common Object Request Broker Architecture (CORBA), thereby permitting any CORBA compliant system to utilize the resources of the APS.

Although the present invention is discussed with respect to exemplary protocols, computer languages, and operating systems, the APS can be implemented on any computer system regardless of protocols, languages, or operating system platform. Furthermore, it is recognized by one of ordinary skill in the relevant art that the present invention relates to gathering any type of information in general, even though the present invention is discussed with respect to telecommunication information.



The APS is a geographic information system that supports, for example, telecommunication service providers in their mission to deploy telecommunication services and to manage their network infrastructure. In general terms, the APS is an organized collection of computer hardware, software and geographic data that provides entry, storage, query and display of geographic reference information related to facilities and service coverage.

Figure 1 shows the hardware architecture of the APS, in accordance with an embodiment of the present invention. The APS system 101 includes a web server 103 that communicates with a database server 105 over, for example, a local area network (LAN) (not shown). The web server 103 interfaces with a map database 107 to retrieve map data; according to one embodiment, the database 107 resides within the web server 103 itself (as shown in Figure 3). Alternatively, the database 107 can be situated external to the web server 103. In an exemplary embodiment, the web server 103 is a server-class IBM-compatible running the Microsoft Windows NT operating system.

The APS 101 provides a web application that returns a map and associated attribute information (e.g., telecommunication information) based on user input of a service address (e.g., city/state/zip code, street address/zip, or and so on). The input address is validated and mapped to reference information, which, according to one exemplary embodiment, includes rate centers, ILEC wire centers, on-ring and LIT/CAP (Competitive Access Provider) buildings, switch information, and switch collocation (COLLO) information. A wire center is the geographic serving area of an end office (or central office) that describes the location of the local loop between the customer and the first (highest numeric class) switch. Traditionally, the end office has been limited by the maximum transmission length of copper wires. Rate center pertains to

telephone company-designated geographic locations assigned vertical and horizontal coordinates between which mileage are determined for the charging of private lines. That is, the distance between two rate centers is used to compute the charge rates for telecommunication services provided in the area between the rate centers. COLLO information pertains to the facilities of a third party where a piece of equipment of the telecommunication service provider resides.

To retrieve, for example, requested telecommunication information, client stations 109 access the web server 103 using standardized web browsers (e.g., Microsoft Internet Explorer, Netscape, and so on); this retrieval operation is more fully discussed in Figure 3. To serve these client stations 109, web server 103 executes JAVA applications (e.g., JAVA servlets). JAVA provides operating system independence, enabling language flexibility and code-reuse. Additionally, the web server 103 supports non-web enabled client stations, such as client station 111, via a mapping module application, which is more fully discussed in Figure 2.

As described above, the APS 101 supports two deployments: (1) a client/server solution, and (2) a web application. In the client/server distribution, desktop mapping software (e.g., MapInfo Professional) is loaded on a client station 111 to access the spatial information within APS 101. The desktop geographic application enables the user to perform complex geographic analysis by processing the information provided by the web server 103 and the database server 105.

The database server 105 operates on a UNIX platform (e.g., HP-UX 10.20 by Hewlett-Packard); according to one embodiment, the hardware is a Hewlett-Packard server (e.g., T-class). The database server 105 interacts with database 113, which stores information (e.g., telecommunication information such as wire centers, rate centers, PSAP, LIT/CAP, switch

locations) from a myriad of data sources 115. The data sources 115, in one embodiment, include commercially available data (e.g., rate center, wire center, PSAP, customer demographic information) as well as data from the information systems of the telecommunication service provider (e.g., switch information, switch collocation information, and CAP buildings). As used  
5 herein, the term telecommunication information include information from these data sources 115. (A myriad of non-telecommunication information may also be used in another embodiment of the invention accordance with other industries seeking to relate address information to data sources about regions which have access to or near the address.) Furthermore, the APS 101  
10 interfaces with many external systems (not shown) using CORBA 119. Specifically, (as seen in the figure) client station 117 can access information from database server 105 using CORBA 119.

The architecture of the APS 101 enables the return of a standard API (Application Programming Interface) that outputs all pertinent geographic information. This approach  
15 advantageously reduces development and implementation time for new interfaces to other systems by leveraging an existing multi-purpose (or generic) API, rather than requiring new development for each new system interface. Additionally, APS 101 brings the power of geographical based analysis and decision support tools to client stations 109, 111, and 117. These aspects are very helpful in applying the concepts described with respect to the telecommunications examples to other applications in a variety of industries.

20 As a geographical information system, APS 101 defines three distinct types of geographical information: (1) points, (2) lines, and (3) polygons. APS 101 provides the client stations 109, 111, and 117 with the ability to query this "spatial" data; for example, to map an

input address to a rate center (a point to a polygon), determine the distance from a building to a switch (point to point) or view all collocation switches within a serving wire center (point to polygon). A spatial query combines geographic polygons, lines and points; this information can be represented by different icons on a map, displayed as text on a screen, or distributed to other systems via a messaging interface. Once again, these options allow easy transition from the telecommunications examples provided herein to applications in other industries.

JAVA applications coupled with CORBA compliant middleware enables object to object communication between the objects in client and server roles. Middleware is software that is transparent to a user, which takes two or more applications and makes them work seamlessly together. With middleware technology, a user can design an ordinary component to provide its regular function, and then insert an appropriate middleware mix when the component is built or created at run time. In a CORBA environment, an Object Request Broker (ORB) receives request for services of software modules from programs on clients (e.g., client stations 109, 111, and 117) and servers 103 and 105. The JAVA/CORBA ORB middleware enables distribution of objects, making the APS 101 appear as a single system.

In a CORBA environment, a program makes a request for services of software modules through an ORB, and thus, does not need to know the design and composition of the program, which includes the software. In client/server applications, an ORB is an interface to which the client station 117 makes a request for service from a software object, which in this case is within database server 105. The ORB then directs the request to the server (e.g., server 105) hosting the software object and returns the resulting value(s) of the service to the client (e.g., client station 117).

In an object-oriented programming environment, a client is defined as a member of a class or group that uses the services of another class or group to which the client is not related by way of inheritance from a common class or group. More generally, a client is a software module that requests a service provided by another software module. The client uses the requested service without having to know any working details about the other software module or the service. In a network environment, a server is defined as a computer or program that responds to commands from a client.

CORBA software objects are components of intelligence that may reside anywhere on a network. They are packaged as binary components which remote clients may access via method invocations. Both the language and compiler used to create server software objects are transparent to clients. Clients have no need to know where the distributed software object resides or on what operating system it executes. The distributed software object may be in the same process or on a machine that sits across a large network. Additionally, clients have no need to know how a server software object is implemented. For example, a server software object may be implemented, for example, as a set of JAVA classes, or it may be implemented as a large COBOL (Common Business-Oriented Language) program. The client only needs to know the interface its server software object publishes. The interface then serves as a binding contract between client stations 109, 111, and 117 and servers 103 and 105.

Such interface specifications are written in a neutral Interface Definition Language (IDL) that defines a component's boundaries; that is, its contractual interfaces with potential clients. Components written to IDL are accessible across languages, tools, operating systems, and networks.

IDL-specified methods can be written in and invoked from any language that provides CORBA bindings. Examples of such languages include JAVA, C, C++, Ada and Smalltalk. Programmers interact with CORBA software objects using native language constructs. IDL provides operating system and programming language independent interfaces to all the services and components that reside on a CORBA bus. This allows client and server software objects written in different languages to communicate with one another. OMG IDL is utilized to specify a component's attributes, the parent classes from which the component inherits, the exceptions it raises, the typed events it emits, and the methods its interface supports, including the input and output parameters and their data types. The CORBA IDL allows component providers to specify in a standard definition language the interface infrastructure of the software objects that they provide.

The CORBA Object Request Broker is the software object bus. As previously indicated, the ORB enables software objects to transparently make requests to, and receive responses from, other software objects located locally or remotely. The client is not aware of the mechanisms used to communicate with, activate, or store these server software objects. A CORBA ORB provides a wide variety of distributed middleware services. The ORB allows software objects to discover each other at run time and invoke each other's services. An ORB is much more sophisticated than alternative forms of client/server middleware, including traditional Remote Procedure Calls (RPCs), Message-Oriented Middleware, database stored procedures, and peer-to-peer services. Nevertheless, all these alternative forms could be implemented by one skilled in the art to achieve equivalent functionalities.

Figure 2 shows the software architecture of the APS, according to one embodiment of the present invention. The client stations 109, 111, and 117 and the servers 103 and 105 run TCP/IP (Transmission Control Protocol/Internet Protocol) 201 to communicate among themselves as well as to other external systems (not shown). In particular, web server 103 communicates with database server 105 over a TCP/IP socket. Client station 111 also uses TCP/IP to exchange information with database server 105. One of ordinary skill in the art would recognize that other transport layer protocols can be utilized (e.g., User Datagram Protocol (UDP)).

As web clients, client stations 109 employ the Hypertext Transfer Protocol (HTTP) 203 to exchange information with web server 103. HTTP 203 is an application-level protocol for distributed, collaborative, hypermedia information systems; IETF (Internet Engineering Task Force) RFC (Request for Comment) 2616 specifies this protocol and is incorporated by reference herein in its entirety. HTTP 203 advantageously provides development or modification of the APS 101 independent of the data being transferred.

According to one embodiment, the two primary operating systems supported by APS 101 are UNIX 205 and Microsoft Windows NT 207. Database server 105 runs UNIX 205 in the form of HP-UX 10.20, which complies with the following standards: X/Open's Single UNIX Specification (SPEC1170); X/Open Portability Guide, Issue 4 (XPG4); (System V Interface Definition, Issue 3 (SVID3) level 1 APIs; Open Software Foundation (OSF) Application Environment Specification (AES); and Common Desktop Environment (CDE) standard. Windows NT 207 is run on web server 103.

The APS 101 utilizes a number of applications to provide efficient retrieval of requested information, such as telecommunication information for example. In particular, the web server

103 contains a mapping module 209 as well as a variety of JAVA servlets 211. The JAVA  
servlets 211 provide interaction with a web browser 215 on the client station (e.g., client stations  
109). The mapping module 209 permits the overlay of telecommunication information from the  
database server 105 onto a map with street level detail. In an exemplary embodiment, the street  
5 map is StreetPro by MapInfo. As will be described more fully in Figure 3, the mapping module  
209 generates a map graphic based upon the received telecommunication information. The  
mapping module 209, according to one embodiment of the present invention, is the mapping  
application server MapXtreme by MapInfo. The mapping module 209 provides connectivity to  
live data sources 115 by interfacing with the spatial information database module 213 within  
10 database server 105. The mapping module 209 provides the capability to draw customized  
objects onto a map and to display a specific point on the map (based upon address information).  
Additionally, the mapping module 209 supports spatial selection, whereby a specific location and  
its associated spatial data can be selected for examination. The location can be specified for  
example according to a rectangular area, a radial area, or a polygon.

15 The database server 105 runs UNIX 205 to support the spatial information database  
module 213 and an address validation and geocode module 217. The database server 105  
implements a relational database 219, for example, Informix 9. It is recognized that other  
relational database platforms (e.g., ORACLE 8.05) can be used in the APS 101. The spatial  
information database module 213 enables the integration of spatial data with the existing data of  
20 database 219 by providing a SQL (Structured Query Language) database for spatial operations.  
Additionally, data from the data sources 115 can be efficiently and rapidly loaded onto the  
database 113 by the spatial information database module 213, which further supports the



mapping module 209 in web server 103. According to one embodiment of the present invention, ... the spatial information database module 213 is SpatialWare DataBlade by MapInfo; optionally, it is recognized by one of ordinary skill in the art that other equivalent spatial technology products can be utilized.

5 Furthermore, the database server 105 possesses an address validation and geocode module 217 to provide address validation and geocoding. The term geocoding, as used herein, denotes determination of positional information based upon address information; the positional information may be any of latitude and longitude coordinates, Cartesian coordinates, spherical coordinates, polar coordinates, and so on. The operational details of the address validation and geocode module 217 are discussed below in Figure 3. In terms of its functional capabilities, the address validation and geocode module 217 validates an input address by comparing it with address ranges within a United States Postal Service (USPS) address ZIP+4 database, and subsequently, outputs a validated address (which is in standard format according to the USPS address ZIP+4 database). The address validation and geocode module 217 then geocodes the validated address, returning positional information (e.g., latitude and longitude) to the web server 103. In an exemplary embodiment, the address validation and geocode module 217 includes the CODE-1 Plus software by Group 1 Software to perform the address validation. This operation as well as the operation of the overall APS 101 is described in Figure 3.

Figure 3 shows the operation and interaction among the software modules of the APS 101. In step 301, a client station 109 submits an input address via the web browser 215 to the web server 103, which has a JAVA servlet 211 that processes the input address. The address, as in step 303, is transmitted by the web server 103 to the database server 105, where the address is

validated and geocoded by the address validation and geocode module 217. In turn, the address validation and geocode module 217 outputs a validated address and positional information (e.g., latitude and longitude) to the web server 103 (step 305). In step 307, a JAVA servlet (e.g., MapXtreme servlet (MAPJ)) accesses the spatial information database module 213 to query the database 113 (e.g., Informix database). Exemplary queries are as follows: point-in-polygon to rate\_center for rate\_center\_name and boundary, point-in-polygon to wire\_center for wire\_center\_name, point-in-polygon for PSAP name and boundary, CAP buildings, and switches and collocation switches in the rate\_center. In step 309, the database server 105 returns a mapped object to the web server 103. The web server 103, as in step 311, accesses the map data 107 via the mapping module 209. Thereafter, map data 107 is retrieved (step 313). In an exemplary embodiment, the map data 107 is street data layer associated with MapInfo StreetPro. In step 315, all spatial data are processed by the mapping module 209, which renders a map graphic (e.g., GIF (Graphical Interchange Format) file). The map graphic, per step 317, is sent to the JAVA servlets 211, for transmission to the web browser 215 (step 319).

Figure 4 shows a flow chart of the address validation and geocoding process performed by the address validation and geocode module 217. In general, the address validation process validates an input address and then geocode on a rooftop level of precision. If the input address fails validation, the address validation and geocode module 217 attempts to determine positional information (e.g., latitude and longitude) at the ZIP-9 level, and then the ZIP-5 level (the ZIP-9 level exhibiting greater than ZIP-5 precision because the location area is narrower). In step 401, the input address is received. The address validation and geocode module 217, as in step 403, compares the input address with the addresses in the USPS database (not shown). Next, in step

405 the address validation and geocode module 217 determines whether a match is found in the USPS database; if a match is found, the address is valid. Upon determination that a valid USPS address exists, this validated address is geocoded at the rooftop level to yield the latitude and the longitude. The validated address is returned to the web server 103 (step 409); thereafter, as in  
5 step 411, the positional information is also sent to the web server 103. However, if the input address is invalid, then the address validation and geocode module proceeds to geocode either at the ZIP-9 level (i.e., with the precision of all nine ZIP digits) or the ZIP-5 level, depending on the closest address match (step 413). The ZIP code (5 digits) or ZIP+4 code (9 digits), per step 415, is forwarded to the web server 103. Under this scenario, the latitude and longitude  
10 information can represent the center of the ZIP code area, according to one embodiment of the present invention.

Other embodiments include attributing the latitude and longitude information to other characteristics of the ZIP code area, such as for example, the center of concentration of the population associated with the ZIP code. Alternatively, other attributes for returning a match in  
15 step 413 may be based on any information related to application in a particular industry. For example, road location and traffic volume near a particular latitude and longitude associated with an input address may be useful to a particular industry. This example might be of use in any industry determining where to locate an aspect of their business (e.g., gasoline station, customer service center of agents, product sales site, and so on).

20 Figure 5 shows a GUI that provides a user with a mechanism to enter an address of a service location. According to an embodiment of the present invention, the GUI is an address entry screen 501 that is supported by a web browser 215 on a client station (e.g., client stations

109). The address entry screen 501 includes an address field 503 with a text box 505 for entering street information. Another text box 507 permits entry of the city of the service location. The address entry screen 501 also has a pull-down text box 509 to designate the state of the service location. The user may enter the abbreviation of the state directly in box 509 or click on an arrow 511 to trigger a scrolling list of state abbreviations. The ZIP+4 code field has two text boxes 513 and 515 for entry of the 5-digit ZIP code and the 4-digit extension, respectively. Any of the fields 505, 507, 509, 513 and 515 can be made optional, so long as an individual field or a combination thereof permits the address validation and geocoding process performed by the database server 105 to return valid positional information.

As seen in Figure 5, the address entry screen 501 displays a number of selection criteria in form of check boxes 517 that corresponds to various information, e.g., telecommunication information. However, as mentioned previously, any type of information can be processed; for instance, a manufacturer can maintain product information with the APS 101 based upon demographics of the region. As an additional example, a courier service may wish to manage its distribution channels; in this manner, distribution hubs and their coverage areas can be easily determined. According to one embodiment of the present invention, the selection criteria include the following: rate center (Rate Cntr); wire center (Wire Cntr); switch of a particular telecommunication service provider, e.g., MCI (MCI Switch); end-office collocation switch (EO COLLO); public safety access point (PSAP); and LIT and CAP building (LIT/CAP). LIT/ CAP buildings denote facilities in which the telecommunication service provider has agreements with other CLECS Competitive Access Providers (CAP) to provide access and lease equipment. A

building may have many CAPs associated with it. LIT building signifies that the building is ready to carry traffic and that the customer is ready to provision service.

In an exemplary embodiment, the user can check any one or number of boxes 517 based upon the telecommunication information that is desired. Also, any one of these check boxes 517 can be checked as a default. Checking of each selection criteria boxes determines that particular map layers that are to appear on the generated map graphic. An "All Clear" field 519 unchecks all the boxes 517.

As shown, an "All" check box 521 associated with the Desired Text Details field allows the user to designate whether all available telecommunication information corresponding to the checked boxes 517 should be retrieved. In accordance with one embodiment of the present invention, the All check box 521 is programmed to always be checked; thus, as a default, the APS 101 returns all the text details of the telecommunication information. The address entry screen 501 additionally permits the user to enter a value in text box 523, which is associated with the Initial Display Size field, thereby, specifying the scale of the map that is to be generated by the web server 103. According to this example, the value represents miles. The range of this value depends on the sizing and capacity of the APS 101; in an embodiment of the present invention, the range is from 1 to 200 miles. A Yes check box 525 of the Return A Map field permits the user to indicate whether a map graphic is to be generated. If the Yes check box 525 is unchecked, text of the telecommunication information will be displayed, without the map graphic.

The address entry screen 501 has two buttons 527 and 529, which are labeled "MapIt" and "Clear", respectively. The Clear button 529 clears all the fields 503, 505, 507, 509, 513, and

523 and all the check boxes 517, 521, and 523. That is, the Clear button 529 essentially clears and refreshes the screen 501 for a new address. The MapIt button 527 initiates the query to the APS 101 to create a map and display telecommunication available for a particular service location as indicated by the input address information.

5       The About field 531 on the upper right-hand corner of the address entry screen 501 provides a brief description of the APS 101 as well as version information. Also on the upper right-hand corner is a Help field 533 that refers the user to an online APS User Guide, which provides explanatory information on the address entry screen 501 as well as other information on the APS 101.

10       Figures 6A and 6B show a map and information screen 601 of the GUI, which is displayed based upon address information and the specified selection criteria of the address entry screen 501. Assuming the user has indicated that a map graphic is to be generated by checking box 525 and has selected all the available selection criteria boxes 517, a map and information screen 601 (as shown in Figure 6B) is displayed to the user on the client station 109. Figure 6A shows the first view of the map and information screen 601; upon scrolling to the end of the map and information screen 601, a client station displays the view shown in Figure 6B. The map and information screen 601 includes a map graphic 603 that illustrates the service location (as specified by the input address) at a street level. The scale of the map graphic 603 corresponds to the value of the display size in box 523, which, in this example, is 10 miles.

20       The map graphic 603 contains the overlay of icons representing the telecommunication information corresponding to the chosen selection criteria. The map and information screen 601

includes a map legend 605 to identify these icons. For example, a diamond icon 607 denotes a location of the collocation switch within the area of the service location.

The telecommunication information, in text form, are displayed in text box 609 of the rate centers, text box 611 of the wire centers, text box 613 of the MCI switches, text box 615 of the collocation switches, text box 617 of the PSAP, and text box 619 of the CAP/LIT buildings. The map and information screen 601 automatically displays scroll bars for these text boxes (e.g., 613, 615, 617, and 619) if the telecommunication information in the respective categories exceed a predetermined number of lines. That is, frames are used to display information, as appropriate. In this case, the telecommunication information relating to rate centers and wire centers occupy only a single line each; their respective text boxes 609 and 611 do not have scroll bars. It should be noted that screen 601 may represent a map graphic apart from, or in combination with, other information, and any other information need not be displayed with the map graphic.

When information is displayed, such as for example, the telecommunication information, it is associated with each of the selection criteria are specific to the exemplary category. The fields of the Rate Centers text box 609 include the Rate Center Name field 609a and the State field 609b. The Wire Centers box 611 has a Wire Center Name field 611a, a State field 611b, a LATA (Local Access and Transport Area) field 611c, and an NPA (Numbering Plan Area) field 611d. The switch information text box 613 includes a Label field 613a to identify the switch, a switch CLLI (Common Language Location Identification) code field 613b, a Switch Type field 613c, and a Company field 613d to indicate the company that owns the respective switch. The collocation switch text box 615 encompasses the following fields: a Label field 615a to identify the collocation switch, a COLLO CLLI field 615b, a Within WC (wire center) field to indicate

whether the collocation switch falls within the boundary of the wire center, and a Distance From Input Point field 615d to specify the distance from the input address to the particular collocation switch. The PSAP text box 617 includes an Agency field 617a to identify the particular agency, a Coverage field 617b to specify the area of coverage of the PSAP, a FIPS field 617d, a County field 617e, and a Routing Number field 617e to specify the number that the emergency number is translated to (or resolved to).

To inform the user on the information that has been provided to the APS 101, the map and information screen 601 displays the selection criteria check boxes 517 of the Desired Map Details field as well as the input address information 621 (as shown in Figure 6B), which is the actual search address used in the address validation and geocoding process. Additionally, the map and information screen 601 provides a USPS Validated Address field 623, which includes a ZIP+4 code. It should be noted that if no valid address is found, an appropriate message is displayed under the USPS Validated Address field 623; for example, "None Found." The Latitude and Longitude field 625 is displayed; in this example, this positional information has been calculated with rooftop precision. The map and information screen 601 has a ReDrawMap button 627, which triggers the regeneration of the map graphic 603. The user can click on the ReDrawMap button 627, for example, if different selection criteria are desired or the map graphic 603 display size has been altered.

In addition to the map and attributes listed above, APS 101 can provide distance information from the input address to, for example, switch, collocation switch and building locations. Distance information can be provided either from a straight-line perspective or along the streets from the starting address to the destination. With APS 101, the user also has the



flexibility to perform running distance calculations from one point on the map to another, with any number of intermediate points; this operation is more fully described below with respect to Figure 6C.

The APS 101 is designed to support a number of business functions (e.g., the order entry process). As an illustration, customer service representatives (CSRs) routinely need to determine the distance from the customer location to an ILEC end office for DSL (Digital Subscriber Line) provisioning and the distance from CAP and on-ring buildings for near ring solutions. With the distance calculation capability, the CSRs are able to make the distance determination quickly.

The map and information screen 601 enables distance calculation using the map graphic 603. Specifically, the user can designate numerous points on the map graphic 603 for distance calculation by placing two or more icons (which, in an exemplary embodiment, resemble push-pins) onto the map graphic 603. The distance calculation is performed in two ways: (1) between a latest push-pin and the immediately preceding push-pin (i.e., current distance); and (2) from the first push-pin through the last push-pin including all intermediate push-pins (i.e., cumulative distance). In other words, the current distance indicates calculated distance from the previous point to the last point. The cumulative distance indicates total road distance from the starting point through the last point. Alternatively, straight-line distances are calculated directly from the first push-pin to the most-recently positioned push-pin, that need not be a road-distance calculation.

Figure 6C shows a flow chart of the distance calculations, in accordance with an embodiment of the present invention. The ability to place the push-pins 629, 631, and 639 (as shown in Figure 6B) is triggered by first clicking on Distance button 633 (step 671). In step 673,

the user places a first push-pin and a second push-pin; for example, the user places a starting push-pin 629, and an intermediate push-pin 631 (Figure 6B). Next, as in step 675, the current distance is calculated and displayed based upon the placement of the push-pins 629 and 631.

5 Additionally, the cumulative distance is calculated and displayed, per step 677. At this point, the Current Distance field 635 and the Cumulative Distance field 637 would show equal values. If the user has not completed tracing out a route (step 679), the user places another push-pin onto the map graphic 603 (step 681). Upon placing the last push-pin 639, the Current Distance field 635 would display the distance between the intermediate push-pin 631 and the last push-pin 639, while the Cumulative Distance field 637 would show the cumulative distance from push-pin 629 to push-pin 631 plus the distance from push-pin 631 to push-pin 639. If the user has finished tracing out a route, the process ends. As seen in Figure 6B, a Reset button 641 clears the Current Distance field 635 and the Cumulative Distance field 637, eliminating any push-pin icons on the map graphic 603. The distance calculation functionality advantageously provides a mechanism to easily trace out a route and determine its distance, which is useful in effecting engineering changes or answering service availability inquiries.

15 The map and information screen 603 also provides expansive zooming capabilities: rectangular zooming, and zooming via a zoom bar. The user can elect to draw a rectangle 643 of any size within the map graphic 603; a subsequent map graphic 603 is generated with a scale corresponding to the size of the rectangle 643. Alternatively, the user can position a cursor 645 along a zoom bar 647, in which a zoom distance 649 is concurrently displayed corresponding to the position of the cursor 645. In this embodiment, the zoom bar 647 provides the ability to specify continuous zoom values (shown as zoom distance 649). Alternatively, the zoom bar 647

can be configured to specify discrete zoom values corresponding to discrete areas depicted in the zoom bar 674. Upon positioning the cursor 645 over an area of the zoom bar 647 corresponding to the desired level of zoom, as reflected by zoom distance 649, the user can select this level of zoom, for example, by clicking a mouse (not shown). The map and information screen 601 further supports panning of the map graphic 603 via directional icons in form of pan arrows 651.

Figure 7 shows a large view of the map legend 605. The map and information screen 601 permits the user to move the map legend 605 about the screen 601 (Figure 6A) so that the user can customize where the map legend 605 should be situated. The APS 101 retains this customization by the user so that the map and information screen 601 will display the map legend 605 at the location where the user last specified. In other words, the APS 101 stores information regarding the location of the map legend 605 for each individual user independently, for each such users; accordingly, the location information of the map legend 605 is retrieved by the APS 101 in a subsequent user session. Effectively, other users can move the map legend 605 according to their preferences without imposing any particular preference to another user. The map legend 605 can also be minimized to avoid obstructing significant portions of the map and information screen 601.

In view of the functionalities discussed above, the APS 101 supports a number of critical functions within an organization, the exemplary the telecommunication service provider. These functions can include prospecting, sales and marketing, network planning, site or agent location, product distribution, and service provisioning. The APS 101 permits visually targeting prospective customers based on proximity to, for example, LIT/CAP buildings and switches to determine the lowest access cost. Additionally, the APS 101 also supports identification of

clusters of prospects with high revenue potential. The APS 101 ensures that no prospects will be targeted in municipalities that cannot be served by telecommunication service provider, without excluding surrounding or overlapping rate centers.

Further, the sales and marketing department can utilize APS 101 to identify the correct rate center based on physical location rather than NPA/NXX. As such, by using the information retrieved by the APS 101, the telecommunication service provider can minimize the number of rejected orders arising from incorrect switch and NPA/NXX assignment. APS 101 also provides the sales organization the capability to identify the services available for a location (e.g., HDSL (High-bit-rate Digital Subscriber Line)), which is only available to customers within 12,000 feet of a switch). Further, the sales organization can rapidly identify the correct PSAP area so that E911 service routing and dispatch is set up correctly. The marketing organization of the telecommunication service provider, using APS 101, can define key business areas (tariff areas, promotional areas, and so on). As indicated above, the APS 101 has applicability to non-telecommunication services. A food delivery service business or door-to-door sales organization, for instance, can quickly tell a potential customer whether the customer's residence falls within the service area.

With respect to service provisioning of telecommunication services, the APS 101 provides the following support functions: determination of the most cost-effective service delivery method to use by basing this selection on address rather than NPA/NXX, and determination of which switches/collocation switches a customer can be provisioned to based on serving wire center or LATA. The APS 101 also supports the capability to provision service based upon "political" considerations in that the APS 101 can filter and/or sort out information

with respect to deployment of services requiring the use of a competitor's facilities, services, and so on. For example, the collocation switches can be prioritized according to the third party telecommunication service provider (or vendor). In a competitive environment, it is preferred that a telecommunication service provider utilize the facilities or services of another provider that poses the least threat to the telecommunication service provider's market position. A weighting function can be applied to all providers in a service area to prioritize preferred providers over , for example, competitors. Additionally, the engineering organization can utilize APS 101 to plan and manage network growth. Specifically, APS 101 permits network planners with the capability to identify the best place to locate new facilities for a target market.

The APS 101 provides a more targeted GUI for rapidly obtaining specific telecommunication information. Figure 8 shows a GUI, according to an embodiment of the present invention, which is used to determine service availability with respect to a particular location. The GUI includes two screens: a service location address entry screen, and a service availability result screen. In this example, the service is HDSL, which is a distance dependent service. Similar to the address field of the address entry screen 501, as discussed above, the service location address entry screen 801 has an address text box 803 for the street, a city text box 805 for the city, a state pull-down text box 807 for the state, and ZIP+4 text boxes 807 and 811. A Clear button 815 is provided to allow the user to clear all the entry text boxes 803, 805, 807, 809, and 811. The user launches the query to the APS 101 by clicking a Go button 813.

Figure 9 shows a service availability result screen 901, according to one result scenario (i.e., service is not available). The service availability result screen 901 displays an Input Address field 903 to repeat the address information that was entered by the user as a way to

ensure that the user has entered the correct address information. Next to the Input Address field 903 is a Validated Address field 905. Additionally, the positional information is captured in the Latitude and Longitude field 907. The telecommunication information that was obtained from the APS 101 include the identity of the wire center that is nearest the service location (as specified by the input address) under the Wire Center field 909, the collocation switch that is HDSL capable under the HDSL Capable Collocation switches field 911, and a Within Range field 913 to indicate whether the HDSL is within range of the service location. The service availability result screen 901 also provides a text box 915 to provide a detailed description of why the service is not available.

Figures 10A and 10B show the service availability result screens under two different scenarios in which service has been indicated as available. Figure 10A shows the case where HDSL is available in the service location specified, as evident by the Within Range field 913. In Figure 10B, the input address failed validation; therefore, the validated address is based upon ZIP-9.

Figure 11 illustrates the case in which the input address also failed USPS address validation. This scenario differs from that of Figure 10B because geocoding cannot be performed based on ZIP-9 or ZIP-5.

Figure 12 shows a data model used in the address presentation system, according to an embodiment of the present invention. It is recognized by one of skilled in the art that the particularities of the data definitions are not needed to implement the APS 101; these particularities can be tailored and defined according to the design requirements of the telecommunication service provider. The APS 101 utilizes a number of tables associated with

the telecommunication information, as follows: CAP\_BUILDING table 1201, PSAP table 1203, EXCHANGE\_INFO table 1205, COLLO\_INFO table 1207, SWITCH\_INFO table 1209, and RATE\_CTR table 1211. The APS 101 also use an ADDR\_INFO table 1213 and a CUSTOMER\_INFO table 1215.

5           The three key polygon type tables are the EXCHANGE\_INFO table 1205, the RATE\_CTR table 1211, and the PSAP table 1203. The EXCHANGE\_INFO table 1205 pertains to the wire center boundary and includes the following fields: a WIRE\_CTR field 1205a, an OCN (Operating Company Number) field 1205b, and a SPATIAL\_GEOMETRY field 1205c. The RATE\_CTR table 1211 has a RATE\_CTR\_NAME field 1211a and a  
10       SPATIAL\_GEOMETRY field 1211b. The PSAP table 1203, which provides spatial data for the PSAP area, has a SPATIAL\_GEOMETRY field 1203a, an AGENCY field 1203b for the identity of the agency, and a TEN\_DIGIT\_NO field 1203c for storing the ten-digit phone number that the emergency number translates into. Each of the SPATIAL\_GEOMETRY fields 1203a, 1205c, and 1211b contains a spatial description for the respective polygon.

15           The tables that provide point data are the CAP\_BUILDING table 1201, the ADDR\_INFO table 1213, the COLLO\_INFO table 1207, and the SWITCH\_INFO table 1209. The CAP\_BUILDING table 1201 stores fields relating to the CAP buildings. These fields include the following: a VNDR\_CODE field 1201a for vendor code, which identifies the vendor of the equipment; and a CAPABILITY field 1201b for indicating various attributes of the equipment  
20       within the building (e.g., capacity). The CAP\_BUILDING table 1201 has a one-to-many relationship with the ADDR\_INFO table 1213. The ADDR\_INFO table 1213 has the following fields: STREET field 1213a, CITY field 1213b, STATE field 1213c, ZIP field 1213d for the 5-

digit ZIP code, a ZIP-4 field 1213e for the 4-digit extension, a LATITUDE field 1213f, and a LONGITUDE field 1213g. The COLLO\_INFO table 1207 includes a COLLO\_SWITCH\_CLLI field 1207a for storing the CLLI of the collocation switch, and a SWITCH\_CAP field 1207b for specifying the capabilities of the particular switch. The SWITCH\_INFO table 1209 has a SWITCH\_CLLI\_CODE field 1209a for storing the CLLI of the switch and a LEC\_ID field 1209b for storing the identity of the LEC (Local Exchange Carrier) associated with the particular switch. The COLLO\_INFO table 1207 and the SWITCH\_INFO table 1209 are both related to the ADDR\_INFO table 1213 in that the addresses of the collocation switch and the switch are maintained.

The CUSTOMER\_INFO table 1215 provides information on existing and prospective customers of the telecommunication service provider. The CUSTOMER\_INFO table 1215 has the following fields: a CUSTOMER\_NAME field 1215a, a PHONE field 1215b, a REVENUE field 1215c for indicating the revenue that the customer generates for the telecommunication service provider, an ADDRESS field 1215c, a LATITUDE field 1215d, and a LONGITUDE field 1215e. Essentially, the CUSTOMER\_INFO table 1215 stores customer information that enable a more targeted marketing effort.

Each of the above examples illustrate the flexibility of the present invention. As shown above, any variety of detailed information may be used in a system such as that described herein for use in any industry for decisions such as, for example, prospecting, sales and marketing, network planning, site or agent location, product distribution, and service provisioning.

Figure 13 illustrates a computer system 1301 upon which an embodiment according to the present invention may be implemented. Computer system 1301 includes a bus 1303 or other



communication mechanism for communicating information, and a processor 1305 coupled with bus 1303 for processing the information. Computer system 1301 also includes a main memory 1307, such as a random access memory (RAM) or other dynamic storage device, coupled to bus 1303 for storing information and instructions to be executed by processor 1305. In addition, main memory 1307 may be used for storing temporary variables or other intermediate information during execution of instructions to be executed by processor 1305. Computer system 1301 further includes a read only memory (ROM) 1309 or other static storage device coupled to bus 1303 for storing static information and instructions for processor 1305. A storage device 1311, such as a magnetic disk or optical disk, is provided and coupled to bus 1303 for storing information and instructions.

Computer system 1301 may be coupled via bus 1303 to a display 1313, such as a cathode ray tube (CRT), for displaying information to a computer user. An input device 1315, including alphanumeric and other keys, is coupled to bus 1303 for communicating information and command selections to processor 1305. Another type of user input device is cursor control 1317, such as a mouse, a trackball, or cursor direction keys for communicating direction information and command selections to processor 1305 and for controlling cursor movement on display 1313.

According to one embodiment, displaying the GUI screens 501 and 601 is provided by computer system 1301 in response to processor 1305 executing one or more sequences of one or more instructions contained in main memory 1307. Such instructions may be read into main memory 1307 from another computer-readable medium, such as storage device 1311. Execution of the sequences of instructions contained in main memory 1307 causes processor 1305 to

perform the process steps described herein. One or more processors in a multi-processing arrangement may also be employed to execute the sequences of instructions contained in main memory 1307. In alternative embodiments, hard-wired circuitry may be used in place of or in combination with software instructions. Thus, embodiments are not limited to any specific  
5 combination of hardware circuitry and software.

Further, the data structure of Figure 12 may reside on a computer-readable medium. The term "computer-readable medium" as used herein refers to any medium that participates in providing instructions to processor 1305 for execution. Such a medium may take many forms, including but not limited to, non-volatile media, volatile media, and transmission media. Non-  
10 volatile media includes, for example, optical or magnetic disks, such as storage device 1311. Volatile media includes dynamic memory, such as main memory 1307. Transmission media includes coaxial cables, copper wire and fiber optics, including the wires that comprise bus 1303. Transmission media can also take the form of acoustic or light waves, such as those generated during radio wave and infrared data communications.

15 Common forms of computer-readable media include, for example, a floppy disk, a flexible disk, hard disk, magnetic tape, or any other magnetic medium, a CD-ROM, any other optical medium, punch cards, paper tape, any other physical medium with patterns of holes, a RAM, a PROM, and EPROM, a FLASH-EPROM, any other memory chip or cartridge, a carrier wave as described hereinafter, or any other medium from which a computer can read.

20 Various forms of computer readable media may be involved in carrying one or more sequences of one or more instructions to processor 1305 for execution. For example, the instructions may initially be carried on a magnetic disk of a remote computer. The remote

computer can load the instructions relating to displaying the GUI screens 501 and 601 remotely into its dynamic memory and send the instructions over a telephone line using a modem. A modem local to computer system 1301 can receive the data on the telephone line and use an infrared transmitter to convert the data to an infrared signal. An infrared detector coupled to bus 1303 can receive the data carried in the infrared signal and place the data on bus 1303. Bus 1303 carries the data to main memory 1307, from which processor 1305 retrieves and executes the instructions. The instructions received by main memory 1307 may optionally be stored on storage device 1311 either before or after execution by processor 1305.

Computer system 1301 also includes a communication interface 1319 coupled to bus 1303. Communication interface 1319 provides a two-way data communication coupling to a network link 1321 that is connected to a local network 1323. For example, communication interface 1319 may be a network interface card to attach to any packet switched local area network (LAN). As another example, communication interface 1319 may be an asymmetrical digital subscriber line (ADSL) card, an integrated services digital network (ISDN) card or a modem to provide a data communication connection to a corresponding type of telephone line. Wireless links may also be implemented. In any such implementation, communication interface 1319 sends and receives electrical, electromagnetic and/or optical signals that carry digital data streams representing various types of information.

Network link 1321 typically provides data communication through one or more networks to other data devices. For example, network link 1321 may provide a connection through local network 1323 to a host computer 1325 or to data equipment operated by a service provider, which provides data communication services through an IP (Internet Protocol) network 1327

(e.g., the Internet). LAN 1323 and IP network 1327 both use electrical, electromagnetic or optical signals that carry digital data streams. The signals through the various networks and the signals on network link 1321 and through communication interface 1319, which carry the digital data to and from computer system 1301, are exemplary forms of carrier waves transporting the information. Computer system 1301 can transmit notifications and receive data, including program code, through the network(s), network link 1321 and communication interface 1319.

The techniques described herein provide several advantages over prior approaches to providing and processing spatial data associated with telecommunication information. The APS 101 provides the user the ability to select the type of spatial geography and telecommunication information via a robust and user-friendly GUI. The APS 101 returns a map that displays the selected information for the geographic area, along with the accompanying textual data. The user is able to run geographic queries in an ad-hoc mode to answer a wide range of engineering and business problems.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

WHAT IS CLAIMED IS:

1. A method of utilizing a geographical information system, the method comprising:

receiving input address information;

geocoding the input address information; and

outputting positional information in response to the geocoding step.

2. The method according to claim 1, further comprising retrieving requested information based upon the positional information.

3. The method according to claim 2, further comprising receiving selection criteria corresponding to the requested information, wherein the retrieving step is further based upon the selection criteria.

4. The method according to claim 2, further comprising:

validating the input address information; and

selectively outputting validated address information based upon the validating step.

5. The method according to claim 2, wherein the geocoding step comprises determining the positional information at a rooftop level in response to the validating step.

6. The method according to claim 5, wherein the geocoding step further comprises:

determining the positional information at a ZIP-9 level in response to invalid rooftop level validation; and

alternatively determining the positional information at a ZIP-5 level in response to invalid

5 ZIP-9 level validation.

7. The method according to claim 2, further comprising:

selectively generating a map graphic based upon the positional information; and

transmitting the map graphic and the requested information to a client station based upon

10 the selectively generating step.

8. The method according to claim 7, wherein the selectively generating step comprises:

interfacing a map database to retrieve mapping data corresponding to the positional information; and

15 rendering the map graphic based upon the mapping data.

9. The method according to claim 2, further comprising interfacing with an applications client via a CORBA (Common Object Request Broker Architecture) object request broker (ORB).

20 10. The method according to claim 2, wherein the requested information comprises at least one of wire center data, rate center data, PSAP (Public Safety Answering Point) data, CAP (Competitive Access Provider) data, switch collocation data, and switch location data.

11. The method according to claim 2, further comprising:

displaying the requested information on a client station.

5 12. The method according to claim 7, further comprising:

supporting a graphical user interface (GUI) that is on a client station, the GUI providing zoom capability of the map graphic by performing at least one of (1) drawing a rectangle on the map graphic with a cursor and (2) positioning a cursor along a zoom bar.

10 13. The method according to claim 12, wherein a zoom distance is concurrently displayed corresponding to a position of the cursor.

14. The method according to claim 1, wherein the positional information in the outputting step comprises latitude/longitude information.

15

15. A geographic information system comprising:

an application server configured to receive input address information and selection criteria corresponding to requested information;

a database server communicating with the application server, the database server

20 configured to validate and geocode the input address information, the database server outputting validated address information and positional information to the application server; and

a data source coupled to the database server, wherein the database server retrieves the requested information from the data source based upon the selection criteria and transmits the requested information to the application server, and

wherein the application server selectively generates a map graphic based upon validated address and positional information from the database server.

16. The geographic information system according to claim 15, wherein the application server is further configured to optionally provide map scaling information and generate the map graphic based upon the map scaling information.

17. A geographic information system comprising:

an application server configured to receive requested information including input address information;

a database server communicating with the application server, wherein the database server is configured to geocode the input address information; and

a data source coupled to the database server, wherein the database server is configured to retrieve the requested information based upon geocoded input address.

18. The system according to claim 17, wherein the application server is further configured to receive selection criteria which corresponds to the requested information, wherein the database server outputs validated address information and positional information to the application server,



and wherein the database server retrieves the requested information based upon the selection criteria.

19. The system according to claim 18, wherein the application server selectively generates a map  
5 graphic based upon the validated address and the positional information received from the database server and based upon map scaling information received from a client station.

20. The system according to claim 17, wherein the database server comprises a CORBA  
(Common Object Request Broker Architecture) object request broker (ORB) to interface with an  
10 applications client.

21. The system according to claim 17, wherein the database server comprises:  
an address validation and geocode module configured to validate and geocode the input  
address information; and

15 a spatial information database module configured to store and retrieve spatial data associated with the requested information.

22. The system according to claim 21, wherein the address validation and geocode module  
determines the positional information according to a predetermined order of precision based  
20 upon whether the input address information is valid.

23. The system according to claim 22, wherein the predetermined order of precision is at least one of rooftop, ZIP-9, and ZIP-5.

24. The system according to claim 19, wherein the application server comprises:

5 a map database containing mapping data; and

a mapping module configured to interface with the map database to retrieve the mapping data corresponding to the positional information and to generate the map graphic.

25. The system according to claim 19, wherein the application server further comprises a JAVA  
10 servlet to process the input address information, selection criteria corresponding to the requested information, and map scaling information from the client station.

26. The system according to claim 17, wherein the requested information comprises at least one of  
15 wire center data, rate center data, PSAP (Public Safety Answering Point) data, CAP (Competitive Access Provider) data, switch collocation data, and switch location data.

27. The system according to claim 19, wherein the application server supports a graphical user  
interface (GUI) on a client station, the GUI providing zoom capability of the map graphic by at  
least one of (1) drawing a rectangle on the map graphic with a cursor and (2) positioning the  
20 cursor along a zoom bar.

28. The system according to claim 27, wherein a zoom distance being concurrently displayed corresponding to a position of the cursor.

29. The system according to claim 19, wherein the application server supports a graphical user interface (GUI) on a client station, the GUI providing a movable map legend associated with the map graphic.

30. The system according to claim 17, wherein the application server supports a graphical user interface (GUI) on a client station, the application server providing a user with a plurality of push-pin icons for use in determining distance calculation representative of positions of the push-pin icons on a map graphic.

31. The system according to claim 17, wherein the application server and the database server communicates using TCP/IP (Transmission Control Protocol/Internet Protocol).

32. The system according to claim 17, wherein the positional information comprises latitude/longitude information.

33. A computer-readable medium carrying a sequences of instructions for utilizing a geographical information system, the sequences of instructions including instructions which, when executed by a processor, cause the processor to perform the steps of:

receiving input address information;

geocoding the input address information to generate positional information; and  
retrieving requested information based upon the positional information.

34. The computer-readable medium according to claim 33, wherein the processor further  
5 performs the steps of:

outputting positional information in response to the geocoding step; and  
receiving selection criteria corresponding to the requested information, wherein the  
retrieving step is further based upon the selection criteria.

10 35. The computer-readable medium according to claim 33, wherein the processor further  
performs the step of:

validating the input address information; and  
selectively outputting validated address information based upon the validating step.

15 36. The computer-readable medium according to claim 33, wherein the processor further performs  
the steps of:

selectively generating a map graphic based upon the positional information; and  
transmitting the map graphic and the requested information to a client station based upon  
the selectively generating step.

20 37. The computer-readable medium according to claim 36, wherein the selectively generating  
step comprises:

interfacing a map database to retrieve mapping data corresponding to the positional information; and

rendering the map graphic based upon the mapping data.

5 38. The computer-readable medium according to claim 33, wherein the processor further performs the steps of:

interfacing with an applications client via a CORBA (Common Object Request Broker Architecture) object request broker (ORB).

10 39. The computer-readable medium according to claim 35, wherein the geocoding step comprises determining the positional information at a rooftop level in response to the validating step.

15 40. The computer-readable medium according to claim 39, wherein the geocoding step further comprises:

determining the positional information at a ZIP-9 level in response to invalid rooftop level validation; and

alternatively determining the positional information at a ZIP-5 level in response to invalid ZIP-9 level validation.

20 41. The computer-readable medium according to claim 33, wherein the requested information comprises at least one of wire center data, rate center data, PSAP (Public Safety Answering Point)

data, CAP (Competitive Access Provider) data, switch collocation data, and switch location data.

42. The computer-readable medium according to claim 33, wherein the positional information comprises latitude/longitude information.

5

43. A method of determining service availability using a geographical information system, the method comprising:

providing address information and a selection criterion;

retrieving requested information based upon the address information and the selection

10

criterion, the retrieving step comprising,

geocoding the address information, and

outputting positional information.

44. The method according to claim 43, further comprising:

15

validating the address information; and

selectively outputting validated address information based upon the validating step.

45. The method according to claim 43, further comprising selectively generating a map graphic based upon the positional information.

20

46. The method according to claim 45, wherein the selectively generating step comprises:

interfacing a map database to retrieve mapping data corresponding to the positional information; and

rendering the map graphic based upon the mapping data.

5 47. The method according to claim 43, wherein the geocoding step comprises determining the positional information at a rooftop level in response to the validating step.

48. The method according to claim 47, wherein the geocoding step further comprises:

10 determining the positional information at a ZIP-9 level in response to invalid rooftop level validation; and

alternatively determining the positional information at a ZIP-5 level in response to invalid ZIP-9 level validation.

15 49. The method according to claim 43, wherein the requested information comprises at least one of wire center data, rate center data, PSAP (Public Safety Answering Point) data, CAP (Competitive Access Provider) data, switch collocation data, and switch location data.

50. The method according to claim 43, wherein the positional information in the outputting step comprises latitude/longitude information.

20 51. The method according to claim 43, wherein the providing step comprises initiating a telephone call to a customer service representative (CSR).

52. The method according to claim 43, wherein the providing step comprises interfacing with the geographical information system using a web browser.

5 53. A memory for storing spatial data and requested information, comprising a data structure including:

an address table for storing input address information, the input address information being geocoded to generate positional information, the address table comprising a positional information field for storing the generated positional information; and

10 an information table for storing the requested information, the requested information being retrieved based upon the generated positional information.

54. The memory according to claim 53, wherein the information table comprises at least one of:

a CAP building table for storing vendor code data and capability data;

15 a PSAP (Public Safety Answering Point) table for storing PSAP spatial geometry data, agency data, and directory number information;

an exchange information table for storing wire center data, OCN (Operating Company Number) data, and exchange spatial geometry data;

20 a collocation information table for storing collocation switch data and switch capability data;

a switch information table for storing switch CLLI (Common Language Location Identification) code data, and LEC (Local Exchange Carrier) identification data;



a rate center table for storing rate center name data, and rate center spatial geometry data;  
and

a customer information table for storing customer name data, directory number data,  
revenue data, address data, and customer positional information.

FIG. 1

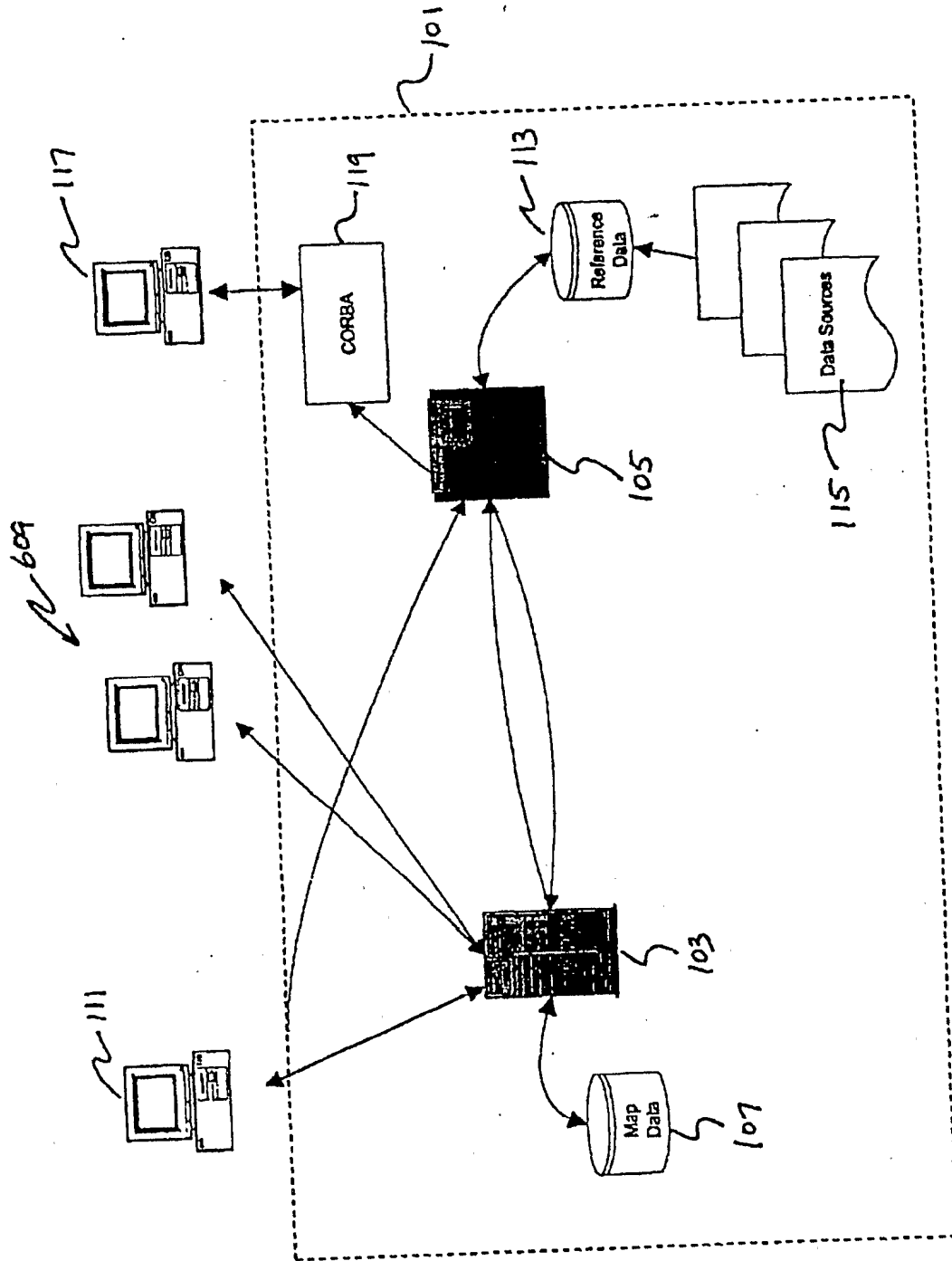


FIG. 2

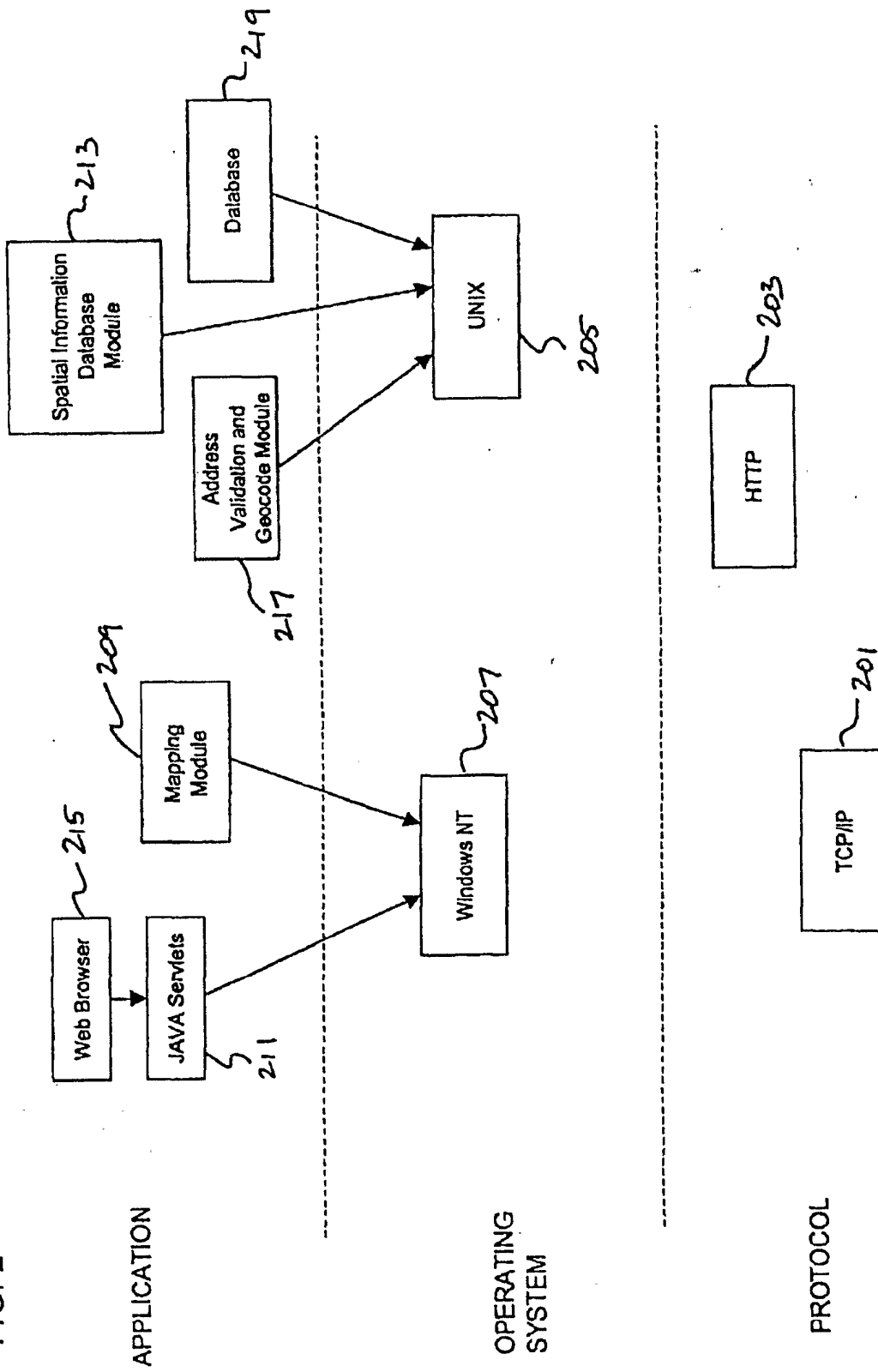


FIG. 3

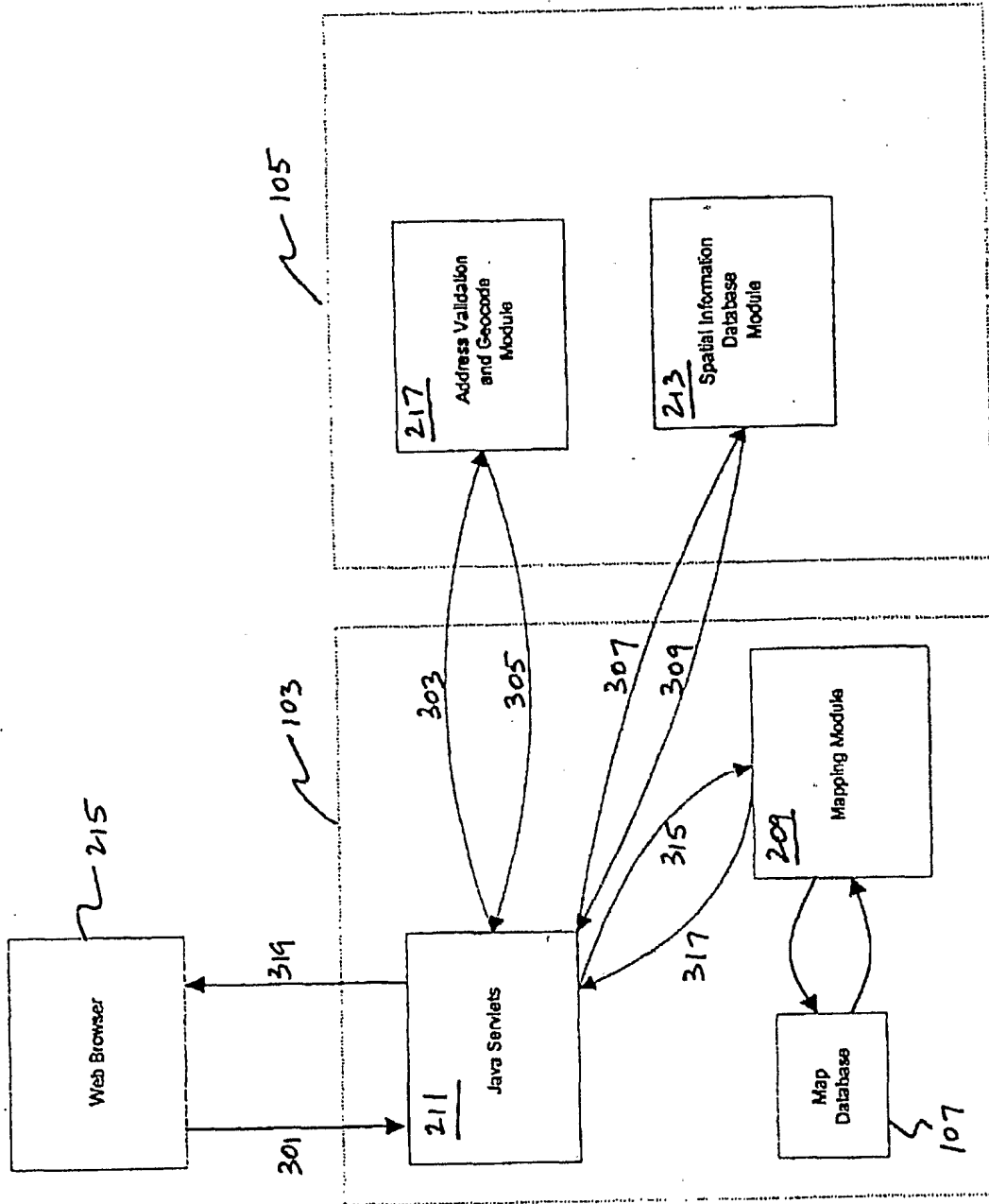


FIG. 4

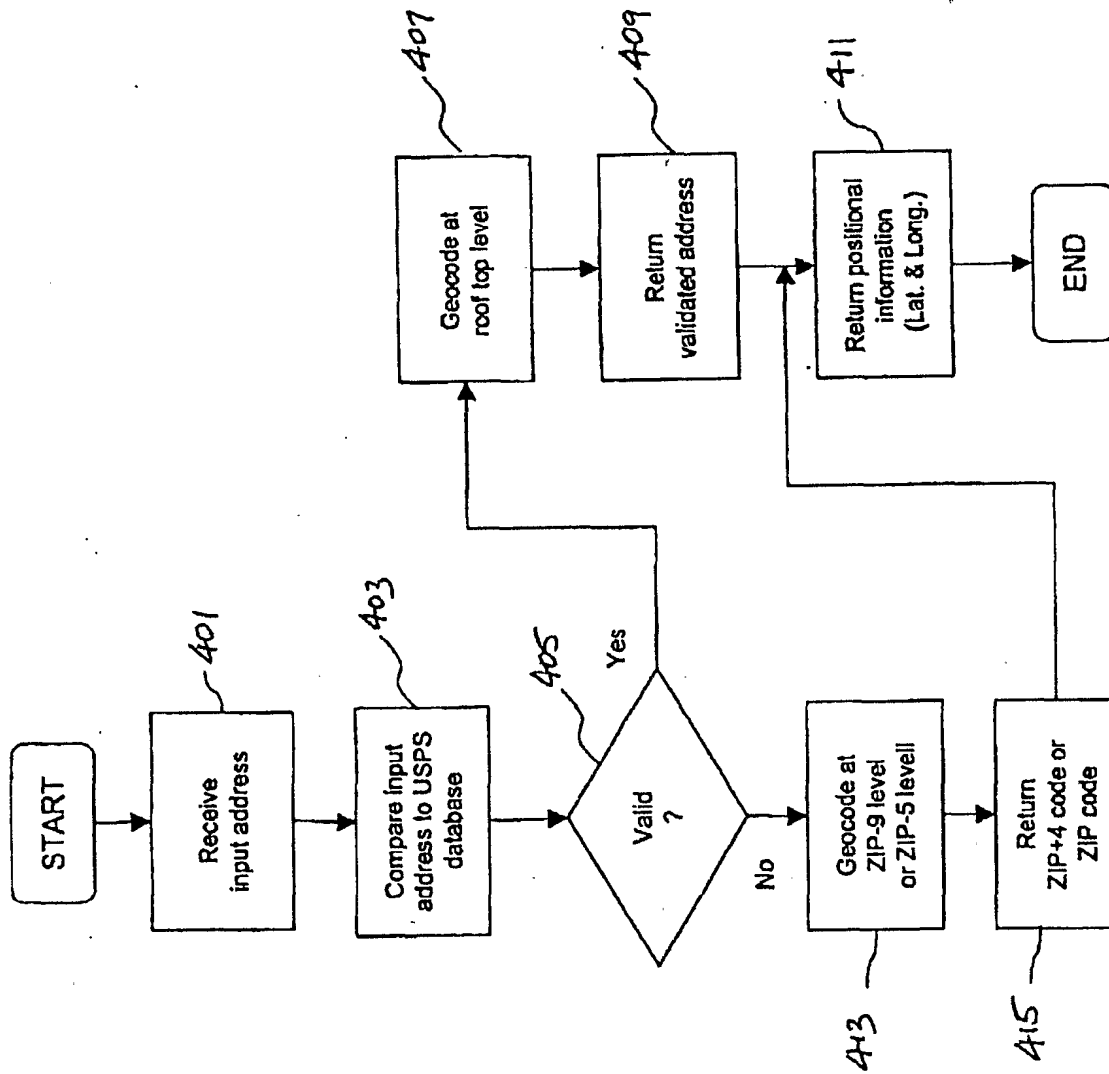


FIG. 5

**MAPS**

MCI Telecommunications  
Address Presentation System

**Service Location**  
(Physical Address,  
No P.O. Boxes,  
Dmit Apt. Floor, etc.)

Address: 907 24th Avenue E 503

City: Seattle 507

State: WA 509

Zip: 98112 511

**Desired Map Details**

All Clear 519

☒ Rate Cntrl

☒ Wire Cntrl

☒ MCI Switch

☒ EO COLLO

☒ PSAP

☒ UNICAP (Map & Text)

517

**Desired Text Details**

All 521

Initial Display Size 523

10 Miles

**Return Map**

Yes 525

527

529

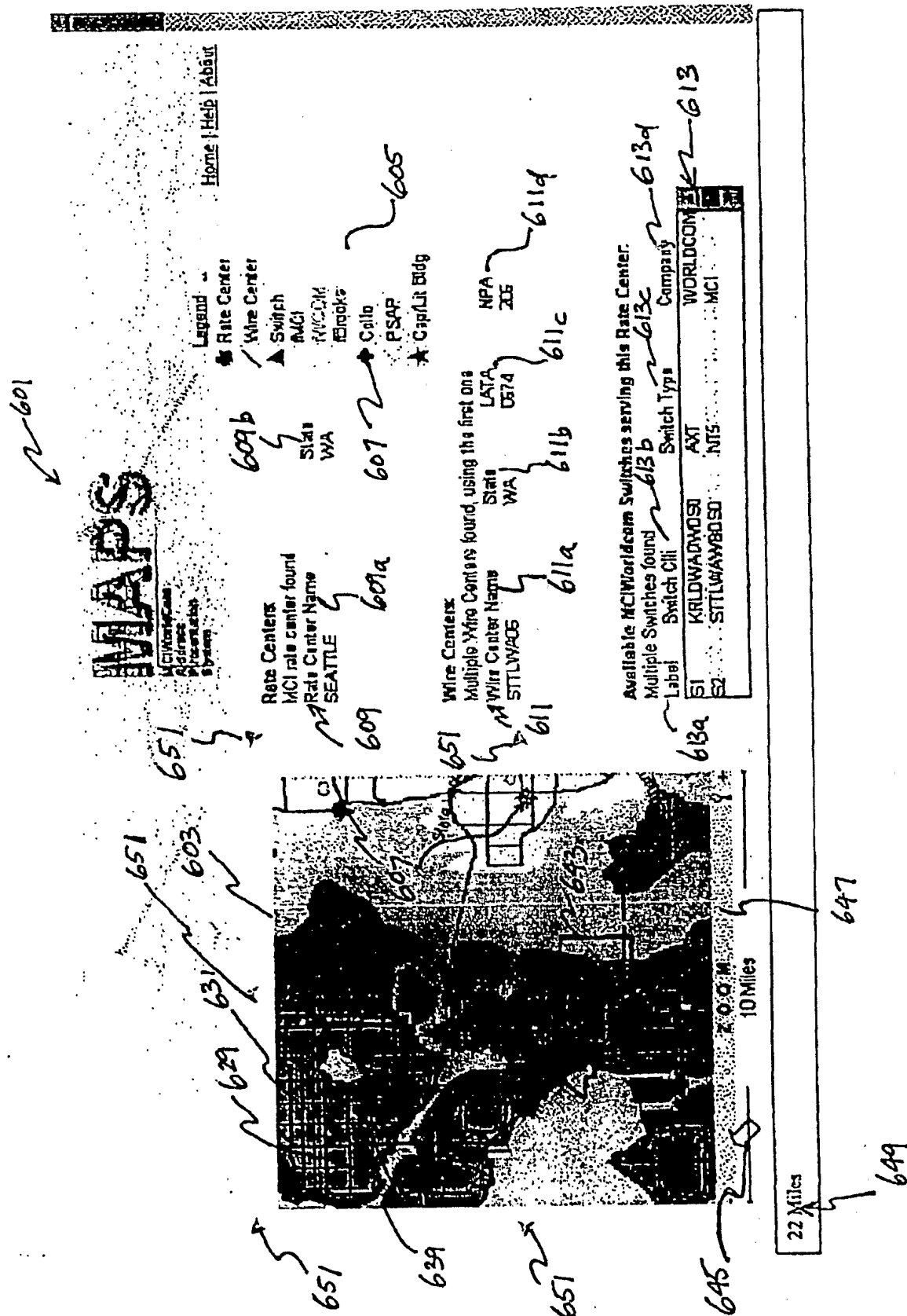
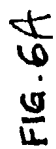






FIG. 6C

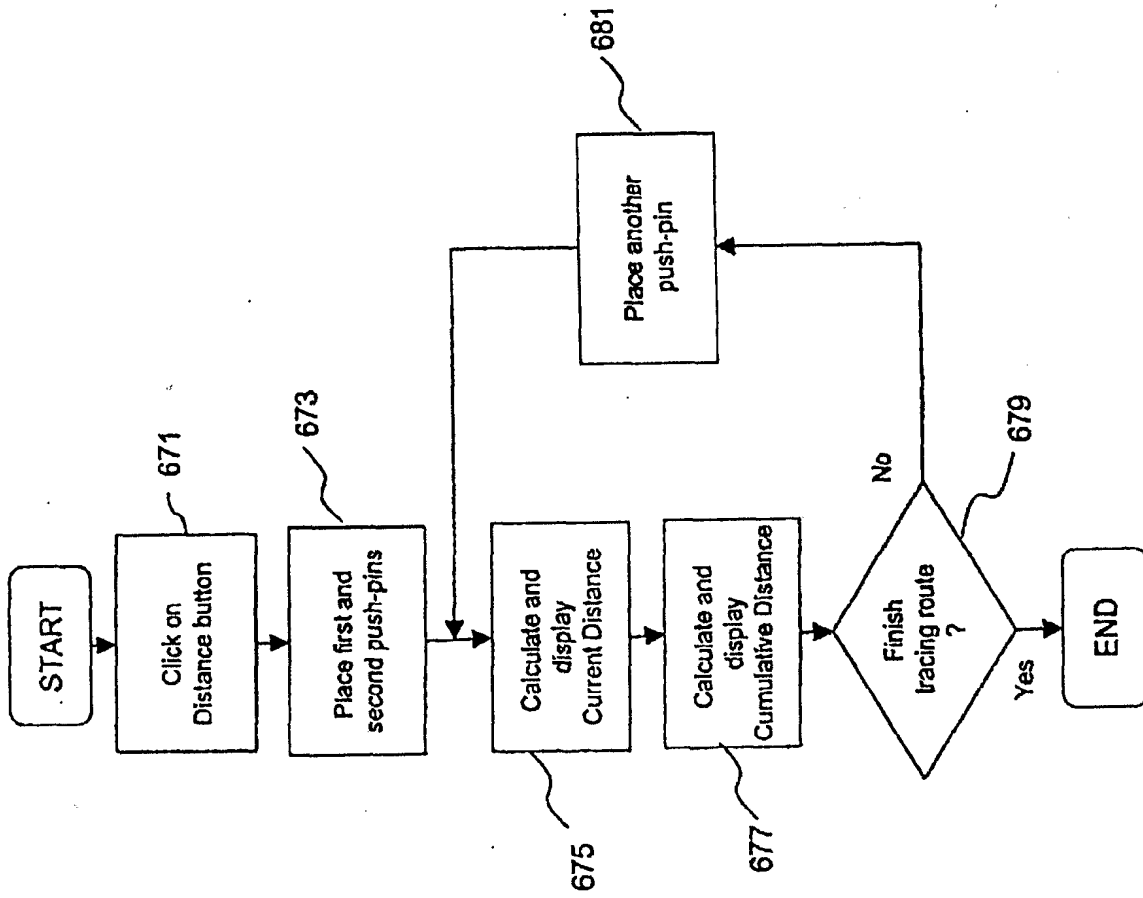


FIG. 7

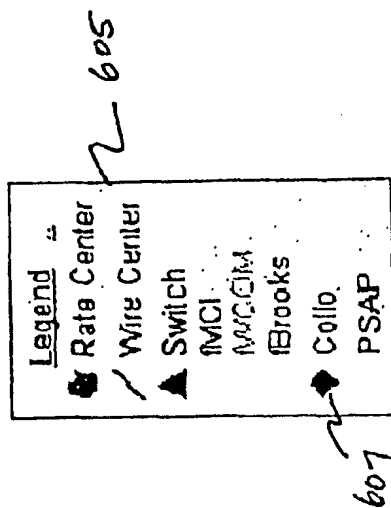


FIG. 8

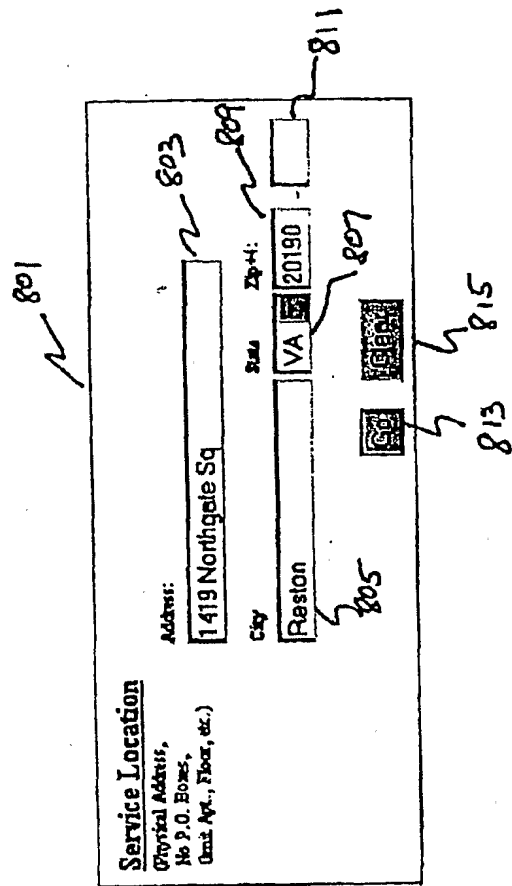


FIG. 9

901

907

905

903

909

913

915

Input Address	3000 Leek Street	3000 LEBK ST	28 728373	95 34459
	Houston TX 77004-2845	HOUSTON, TX 77004-2845		
Time/Date				
HSINTDCA	HSINTXCAHW	No		
HDSL NOT POSSIBLE. This Address is outside the necessary distance from the ILEC End Office, and cannot be supported via HDSL. Please return to NOES and select the next most optimal Service Delivery Method				

FIG. 10A

901

907

905

903

909

913

915

Input Address	4316 4th Street N	4316 4TH ST N	38 872942	77 106681
	Arlington VA 22203-3014	ARLINGTON, VA 22203-3014		
Time/Date				
ARTNVAAR	ARTNVAARHPA	Yes		
The following HDSL-capable calls may be available to service the Input address ARTNVAARHPA				

FIG. 10B

901

903

905

907

909

911

913

915

Input Address	Failed Code 1	Failed Code 2
122 Rt	38.8712	-77.11
Arlington VA 22203-3014	Geocoded based on Zip 9	
Input Address	Failed Code 1	Failed Code 2
ARTNVAAR	ARTNVAARHPA	Yes
The following HDLS-capable codes may be available to service the input address: ARTNVAARHPA		

FIG. 11

901

Input Address

3000 Leask Street  
Alexandria VA

Failed Code 1 address validation. Failed precise geocoding and no match found in LRDS database.

Please visit CSALI to locate possible addresses.

FIG. 12

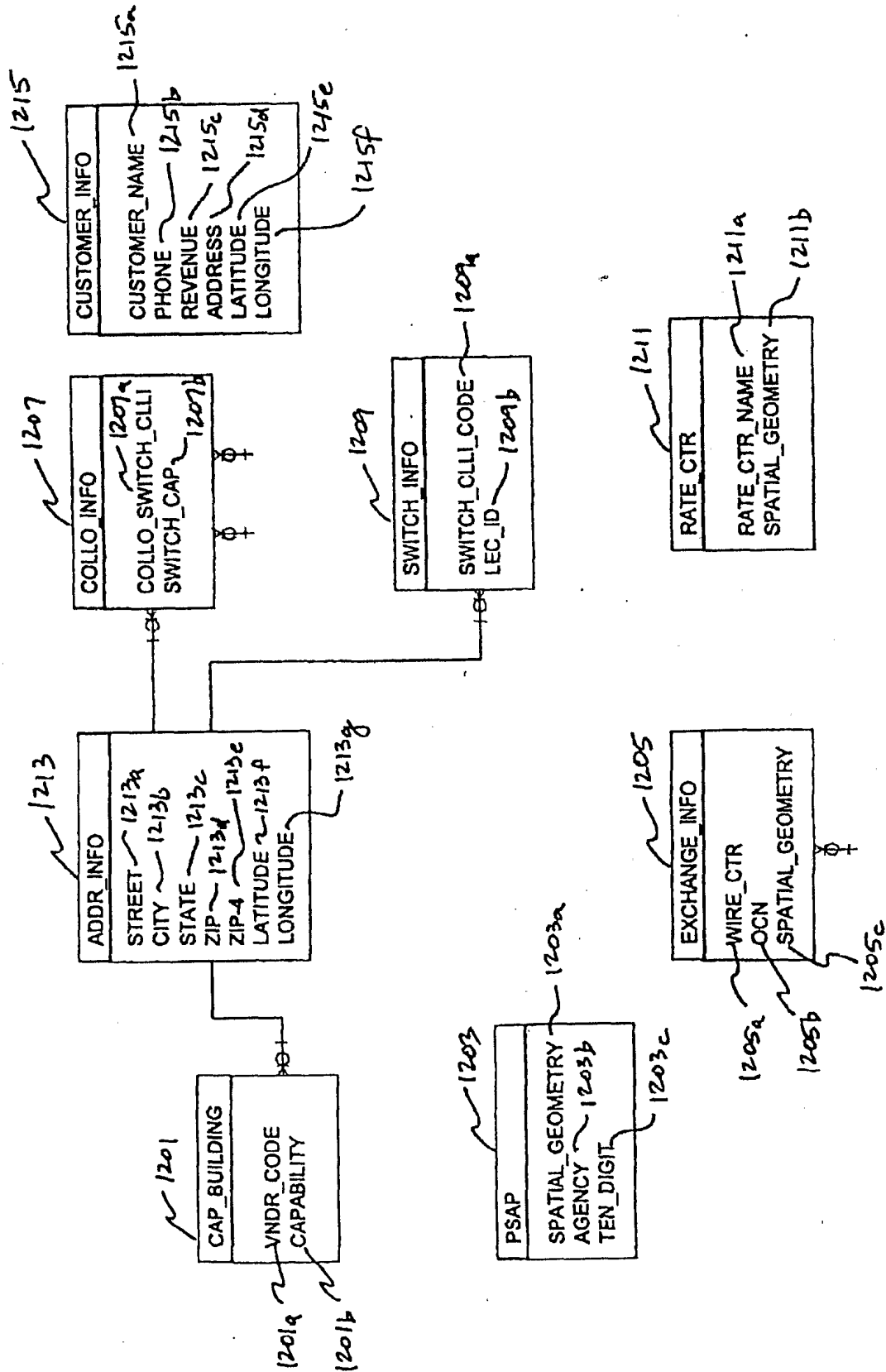


FIG. 13

